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BEYOND COMPARISON™

Biometrics Quality: Technologies, Benefits and Challenges

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Introduction

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- Biometric data quality is a key factor in the performance of identification systems
- Key issues regarding quality
  - Cost
  - Capture time
  - Feature extraction capability (algorithmic)
  - Physical size
  - Number of instances (e.g., number of fingers, multiple images)
  - Performance (accuracy, speed, etc.)
- Discuss
  - Impact of image quality based on actual large scale government and commercial programs
  - R&D efforts to address the system issues associated with image quality as part of the overall identification process
    - Quality Factor
    - Improve Data Quality
    - Dealing with Poor Quality

Fingerprint identification – Most widely used and most accurate biometric

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- Example: European Union EuroDac System (provided by Cogent, in operation since January 2003)
  - "Lights-out" identification for people seeking asylum for all European Member States
  - No failure to enroll – all levels of image quality are accepted
  - Proven true accuracy rate of 99.9% with 0% false acceptance rate
  - 100% search penetration – no filtering or binning to limit search
  - Multi-finger search --- using best "quality" fingers or all "poor quality" fingers available from 10 fingers captured

Quality – Issues & Challenges

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- Practical Issues
  - A solution could be limited by budget, operational environment constraints
  - Less than 10 fingers (application dependent)
  - Quality associated with the physical capture process (operator errors)
- Challenge
  - How to maximize identification performance with varying levels of biometric quality
    - Maximize algorithmic performance to compensate for poor image quality

Quality is Multi-Dimensional

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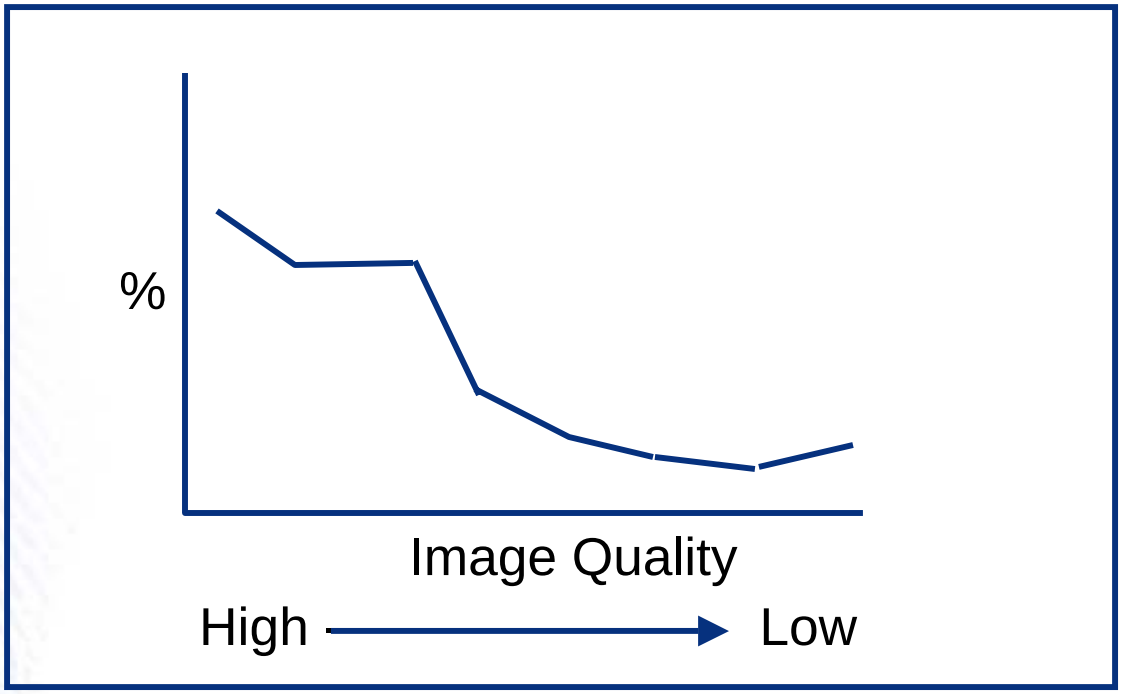
- The quality of digital image --- ***capture device***
- The quality of biometric sample --- ***capture process***
- The quality of biometric feature data --- ***algorithmic capability***



Improving Performance for Poor Quality Images

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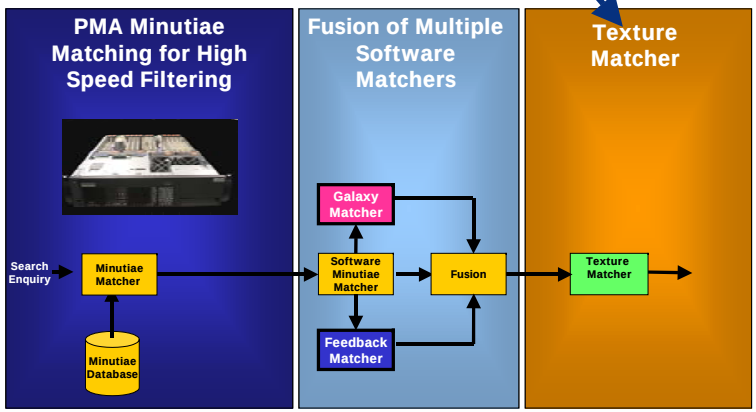
Quality Class	Quality Score	True Accept Rate
GOOD	1	99%
	2	99%
	3	98%
	4	98%
AVERAGE	5	94%
	6	88%
POOR	7	82%
	8-127	54%

Based on 2 finger search

- For quality > 5
  - Multiple independent algorithms
  - Additional feature sets

Texture - "3rd Level Feature Data"



Based on NIST evaluations
Quality 8 images increased to 85% TAR from 54%

Texture Feature Example - Latent

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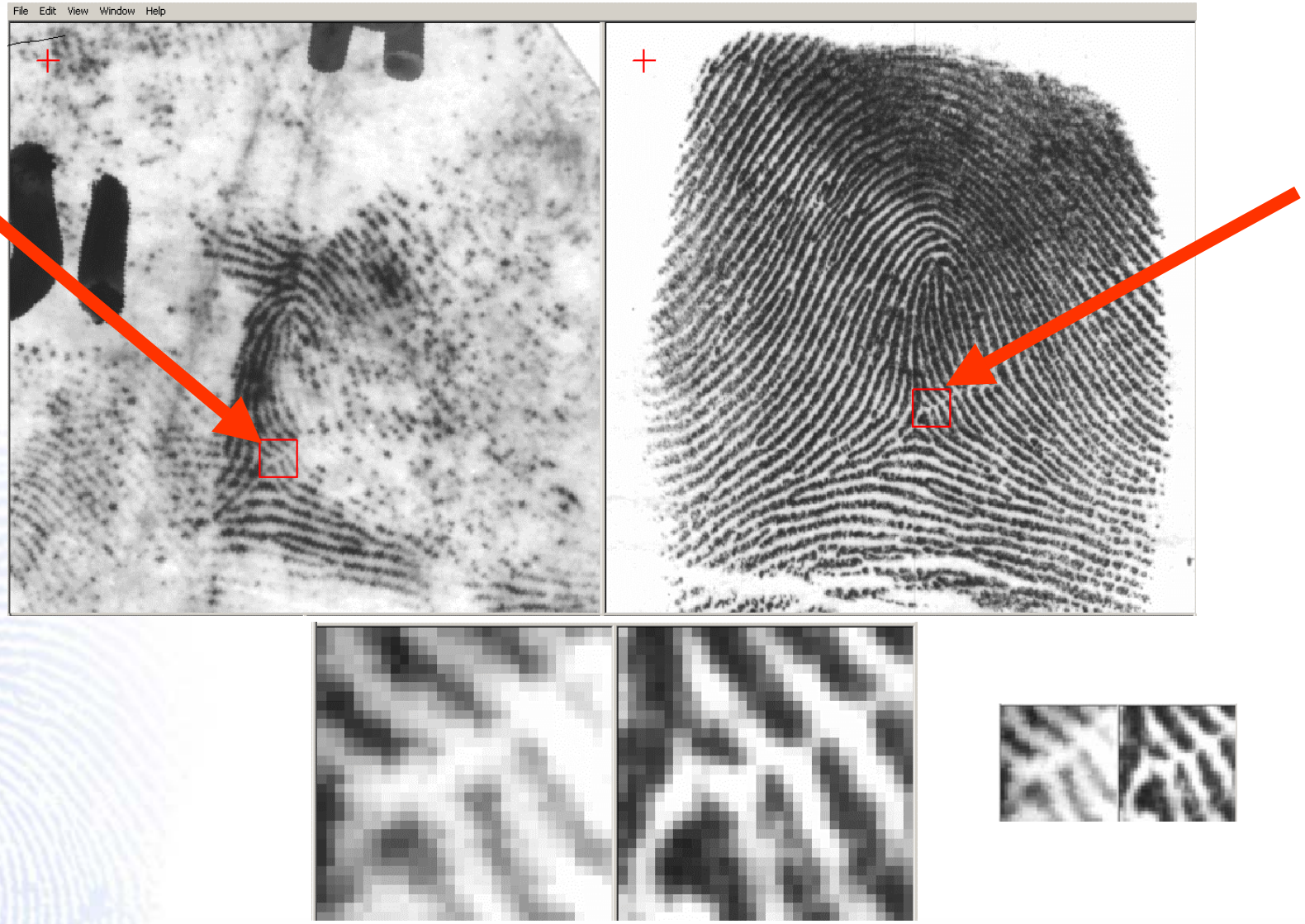

Improved Performance with Galaxy+ Matcher

Orignial Match Score ---- No-hit
Galaxy+ Match Score --- Hit

Multiple Biometrics: Additional Feature Sets

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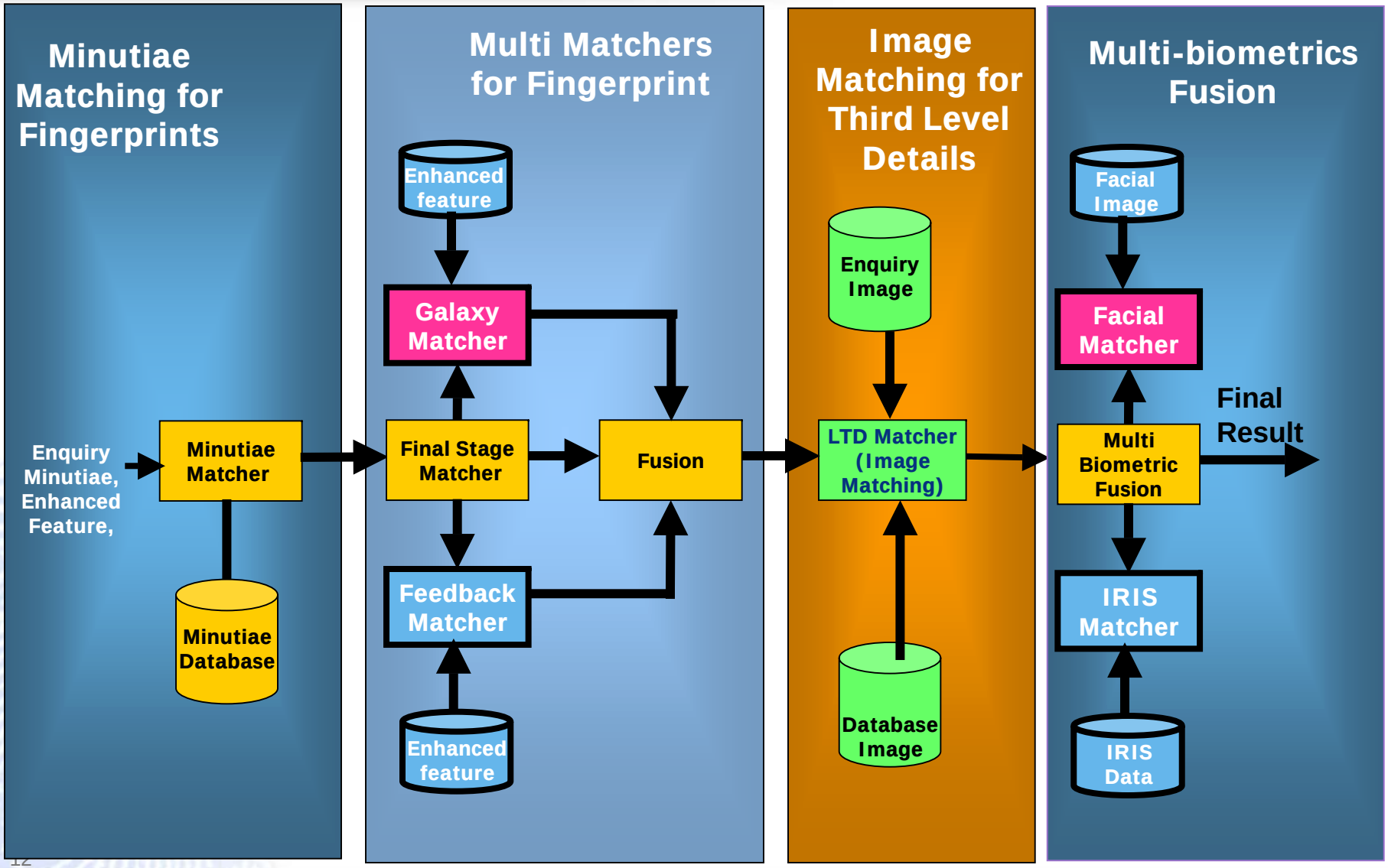
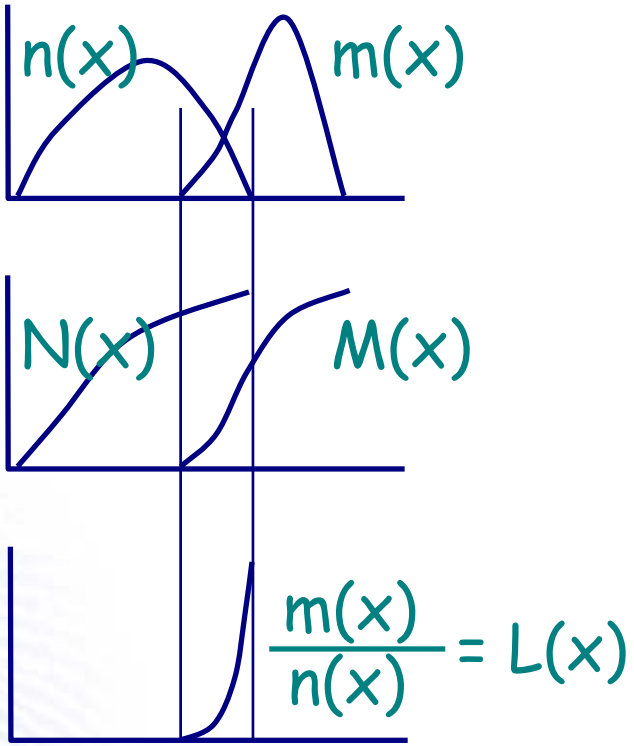


Fusion with Multiple Biometrics



Score level fusion

- Best tradeoff between ease of implementation and power, universally available.
- Many score fusion formulas
- A reliable usage model is using one strong biometrics that will be most suitable for the application as the '**primary**' biometrics and have a second biometrics included for flexibility, risk migration and potential improvement.

Fused score: $s(x) = \log L_A(x) + \log L_B(x) + \ldots$

Conclusions

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- A biometric system has to be resilient in processing all levels of quality and providing high performance
- Quality is multi-dimensional and an identification system must adequately address all aspects
  - The quality of digital image --- ***capture device***
  - The quality of biometric sample --- ***capture process***
  - The quality of biometric feature data --- ***algorithmic capability***

Key challenge for biometric systems

Maximizing identification performance with varying levels of biometric quality

Thank you!